Spatial Distribution of HPV Vaccination Counts & Rates Among Adolescents 13-17 Years Old in Massachusetts (2015)

Sp17 PH0262: GIS for Public Health, Tufts University School of Medicine Public Health and Professional Degree Programs
Cartographer: Jean Jiyoung Lim, DrPH Student / Instructor: Thomas J. Stopka, PhD, MHS
Poster presented at Tufts GIS Poster Exhibition 10 May, 2017
Projected Coordinate System: NAD 1983 StatePlane Massachusetts FIPS 2001 (Meters)

Introduction

Although the overall mortality rate in the U.S. due to cancer has declined in the last several decades, incidence of human papillomavirus (HPV)-related cancers such as of the vulvar, vaginal, cervical, penile, anal, and oropharyngeal sites has been rising. There are approximately 34,200 new diagnoses annually [1, 2]. A growing number of studies identify geographical context based on racial/ethnic and socioeconomic status as an important predictor of not only disparities in cervical cancer rates, but other HPV-related cancer disparities as well [3-5]. The Advisory Committee on Immunization Practices (ACIP) recommends routine vaccination at 11 or 12 years of age for both males and females, and also recommends vaccinations through age 26 years for females and through age 21 years for males who were not previously vaccinated. Depending on age at initial vaccination, the vaccination should follow either a 2-dose or 3-dose schedule [6]. However, HPV vaccination uptake rates have not been adequate in all age and gender groups, widening cervical cancer disparities among population groups that have high incidence of HPV-related cancers and low cervical cancer screening rates [7].

Despite previous scholarship on the effect of geographical context on HPV-related disparities [8], the spatial distribution of HPV vaccination rates in Massachusetts is still poorly understood. In order to understand potential HPV-related disparities in Massachusetts, this study aims to create thematic maps to 1) identify the spatial distribution of HPV vaccination rates/counts among adolescents aged 13-17, and 2) compare the spatial distribution of HPV vaccination rates/counts between males vs. females aged 13-17 in 2015.

Methods

This study assessed the HPV vaccination rate and counts in each zip code in Massachusetts.

1. 2015 data provided by the Massachusetts Immunization Information System (MIIS), Massachusetts Department of Public Health (MDPH) contained vaccination count information by gender and by number of doses received ('1 dose' or '2 or more doses'). Zip codes with less than 5 counts of vaccination were suppressed. We used this dataset to calculate (1) total HPV vaccination counts per zip code, (2) vaccination counts among females and males, and (3) vaccination counts among females and males who received 2 or more doses in 2015.
2. The 2015 5-year American Community Survey (ACS)'s population estimates among female and male adolescents aged 10-17 were used to calculate HPV vaccination rates by zip code across Massachusetts.
3. MassGIS Shapefile (2015) was used to map zip code boundaries, and Census Shapefile (2010) was used to map town boundaries.

The Massachusetts HPV vaccination dataset was merged with the ACS population estimate dataset by zip code using SAS, and the merged file was joined with the MassGIS Shapefile in ArcGIS. Using ArcGIS, Choropleth maps and dot density maps were created to show spatial distribution of vaccination rates and counts across Massachusetts.

We assessed 519 zip codes in Massachusetts that corresponded to the MassGIS Shapefile 2015. Among the data provided by MDPH, only data with zip codes that matched with ACS and MassGIS were included in the analysis. Suppressions were combined using the following rules: 1) <5 counts and <5 counts add to <9 counts, 2) <9 and <9 add to <17 counts, 3) if data were available in one dataset with >0 counts, suppression in the other dataset was treated as 0, and 4) if data are available in one dataset with 0 count, suppression in the other dataset overrides.

Results

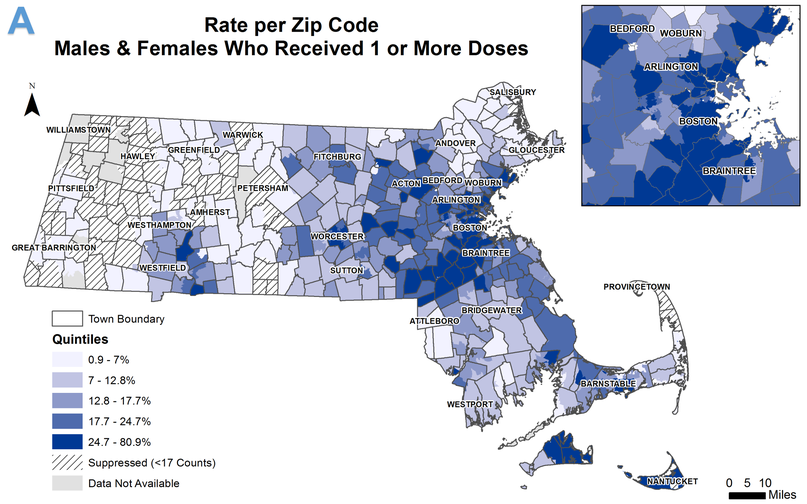
Map A shows the overall spatial distribution of the HPV vaccination rate by zip code across Massachusetts including males and females 13-17 years who received 1 or more doses in 2015. Areas with high rates of vaccination were concentrated in the Eastern regions of Massachusetts. When compared to Map B, Map A also shows that although some areas like Plymouth and West Tisbury have low counts of vaccination, the rates are high when taking the total population estimates of those regions into consideration. Maps C and D show that the spatial distributions of vaccination rates are similar between females and males, and Maps E and F show a similar pattern when comparing females vs. males who received 2 or more doses. The dot density maps also demonstrate the high concentrations of vaccination counts around larger cities, such as Greater Boston, Springfield, Lowell, Brockton, and Worcester.

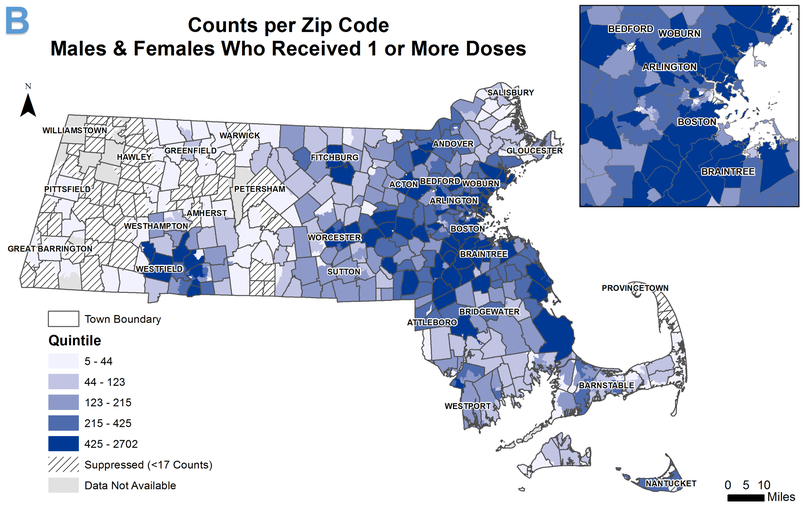
Discussions

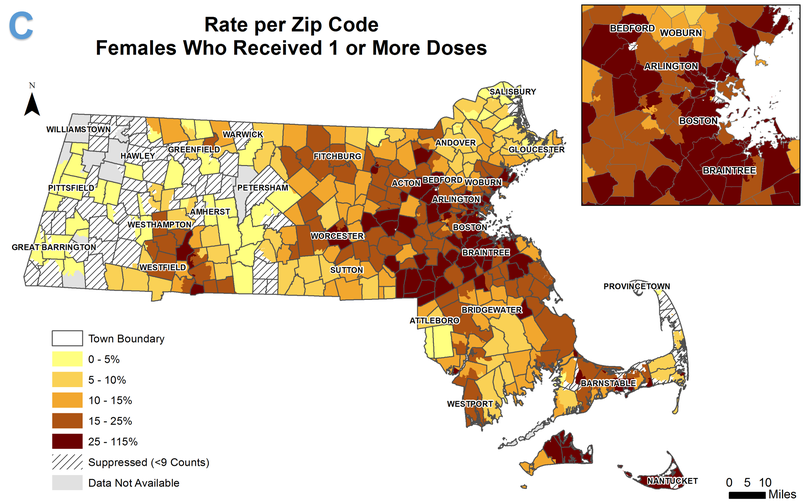
The findings of this study have an important implication. Adolescents who live near urban areas may be more likely to receive HPV vaccinations than those who live farther away from urban areas in Massachusetts. However, this study has several limitations. Since the vaccination rates (among adolescents 13-17 years old) were calculated using larger population estimates for adolescents 10-17 years old as the denominator, the rates might be underestimated. In addition, data were not available for many zip codes. Nevertheless, this study carries weight in that it is the first attempt to map out the spatial distribution of HPV vaccination records among adolescents in Massachusetts. Our findings aim to inform policy makers and future researchers that seek to identify and mitigate the causes of cervical cancer disparities in Massachusetts.

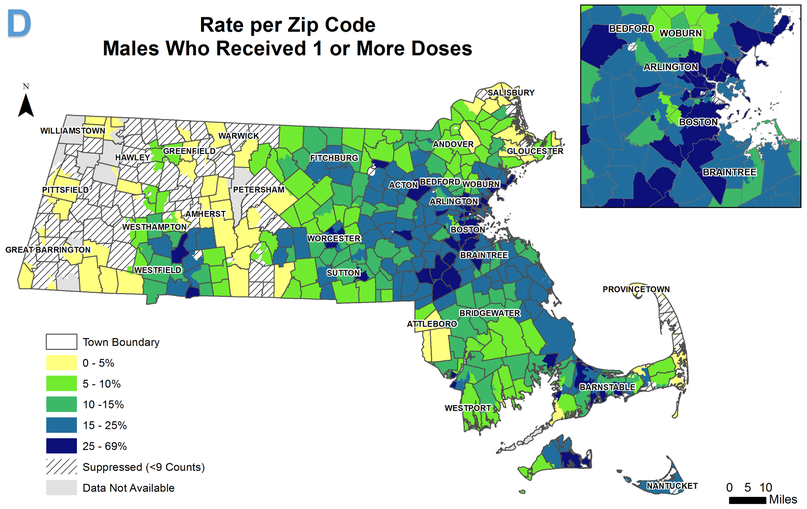
References

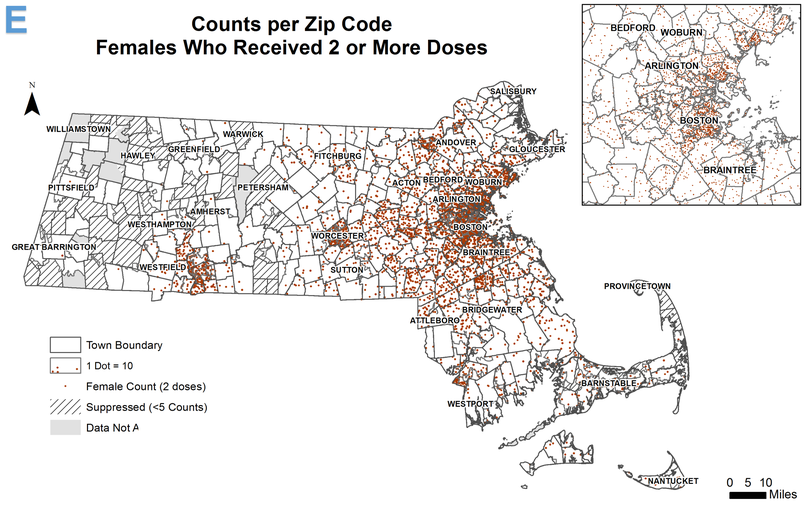
1. Jemal, A. et al. J Natl Cancer Inst. 2013. 105(3):175
2. CDC. MMWR Morb Mortal Wkly Rep. 2012 Apr 20. 61:258
3. Krieger, N. et al. Cancer Causes Ctrl. 1999. 10:525
4. Coughlin, S.S. et al. Soc Sci Med. 2008 Jan. 66(2):260
5. Datta, G.D. et al. Cancer. 2006 Feb 1. 106(3):664
6. Meites, E. et al. MMWR Morb Mortal Wkly Rep. 2016 Dec 16. 65 (49):1405
7. Brisson, M. et al. J Natl Cancer Inst. 2013. 105(3):158
8. Tsui, J. et al. Cancer Causes Control. 2013 Dec. 24(12):2089

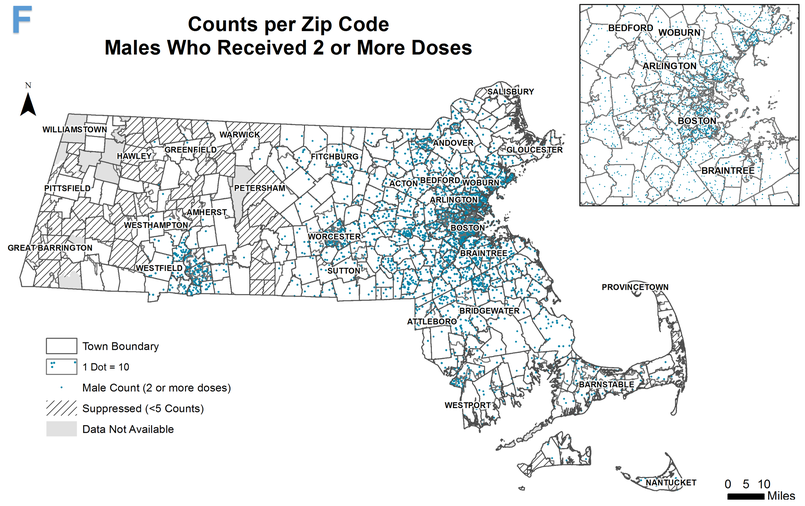












Notes: **All** Refer to the methods section for details about suppression rules; **A** N=122,324 males and females who received 1 or more doses in Massachusetts; Due to data availability in ACS, percent adolescents 13-17 years old who received vaccine(s) is based on the population of adolescents in 10-17 years; **B** N=122,324 males and females who received 1 or more doses in Massachusetts; **C** N=65,205 females who received 1 or more doses. Due to data availability in ACS, percent adolescents 13-17 years old who received vaccine(s) is based on the population of adolescents in 10-17 years. Maximum rate is larger than 100% because the number of vaccination counts in some zip codes exceed the size of the population that resides in the zip codes; **D** N=57,119 males who received 1 or more doses. Due to data availability in ACS, percent adolescents 13-17 years old who received vaccine(s) is based on the population of adolescents in 10-17 years; **E** N=50,935 females who received 2 or more doses. Dots do not represent actual addresses. Points for vaccine receipt are randomly placed within the zip code within which the participants have vaccination records; **F** N=41,052 males who received 2 or more doses. Dots do not represent actual addresses. Points for vaccine receipt are randomly placed within the zip code within which the participants have vaccination records.